Spontaneous Intracerebral Haemorrhage
- Clinical Profile and Predictors of Outcome

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CERTIFICATE

This is to certify that the dissertation titled **“Spontaneous Intracerebral Haemorrhage – Clinical Profile and Predictors of Outcome”** is the bonafide original work of **Dr. CHITRA S.,** in partial fulfillment of the requirements for M.D. Branch– I (General Medicine) Examination of the Tamilnadu Dr. M.G.R Medical University to be held in MARCH 2009. The Period of study was from January 2007 to March 2008.

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DECLARATION

I hereby solemnly declare that the dissertation titled **"SPONTANEOUS INTRACEREBRAL HAEMORRHAGE – CLINICAL PROFILE AND PREDICTORS OF OUTCOME"** was done by me at Madras Medical College and Government General Hospital, Chennai-3 during January 2007 – March 2008 under the guidance and supervision of my unit Chief Prof. M. Jubilee, M.D.

The dissertation is submitted to the Tamilnadu Dr. M.G.R. Medical University towards the partial fulfillment of requirement for the award of M.D degree (Branch-1) in General Medicine.

Place: **SIGNATURE OF THE CANDIDATE**

Date :

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CONTENTS

INTRODUCTION

Of all the cerebrovascular diseases, brain haemorrhage is the most dramatic and from eons has been surrounded by ‘an aura of mystery and inevitability’ and has been given the name, ‘apoplexy’. The prototype is an obese, plethoric, hypertensive male who, while sane and sound, falls senseless to the ground—impervious to shouts, shaking, and pinching – breathes stertorously, and dies in a few hours. A massive blood clot escapes from the brain as it is removed postmortem.

Soranus of Ephesus (98 - 138 A.D.) wrote that “ … hemiplegic paralysis was common in old age, seldom occurred in youth and came most often in winter,………… at times for no apparent reason, at others from clear causes such as indulgence, injury or association with other conditions.”

A lot more is known about intra-cerebral haemorrhage today and the shroud of mystery about it’s pathogenesis is partially unveiled to say the least, and a handful of major risk factors of the disease identified if not them all.

A few of the industrialized countries have gone on to notice a declining trend in the severity and the mortality of intra-cerebral haemorrhages, much of it attributable to rectification of these risk factors over the last three decades.

We have come a long way since the time when Charcot (1881) felt "that if apoplexy was not immediately fatal, most survivors only retained life at the expense of deplorable infirmities and perpetual confinement to bed."

With the arrival of computed tomography of the brain, diagnosis of intra-cerebral haemorrhage has been taken from the age of calculated speculation with details of clinical features, angiograms and 'bloody taps' to the present day of arrival of a definitive diagnosis in a matter of minutes.

A significant reason for the decreasing trend of mortality in the intra-cerebral haemorrhage patients in the industrialized countries have also been due to the identification of the factors which might adversely affect the outcome, stratifying patients and instituting prompt acute stroke care.

Though medical management of intra-cerebral haemorrhage has been the way, surgical management has been known since the times of McEwen, who performed the first successful operation for intra-cerebral haematoma in

1883. Though no definite guidelines exist to decide between the two lines of management, the increasing availability of minimally invasive techniques like stereo- tactic aspiration may make this modality indispensable in the days to come.

But all is not well for a country like India, where there still exist pockets where CT brain is unheard of, stroke care centers unimaginable, and supply almost always short of demand. Thus, identifying definite risk factors, designing and implementing policies to contain them, making prompt and accurate diagnosis, stratifying patients according to outcome predictors, and thereby ensuring prompt referral of deserving critical patients to tertiary centers for intensive management, may be the need of the hour as we wait to embrace the newer advances into our management protocols.

AIMS AND OBJECTIVES

1. To assess clinical profile of patients with Spontaneous Intracerebral Haemorrhage.

2. To identify factors which correlate with outcome of patients' with Intracerebral Haemorrhage.

3. To assess the utility of Intra Cerebral Haemorrhage Score (ICH) and Intra Cerebral Haemorrhage-Graded Scale (ICH-GS) as tools to predict outcome.

4. To apply Siriraj score and the Guy Allen score to classify patients as infarcts and haemorrhages based on the clinical presentation as predicted by the scores.

REVIEW OF LITERATURE

Intracerebral haemorrhage accounts for 10 to 15% of first time strokes world over[1]. Incidences are predicted to be higher in Asian population[2]. The 30 day mortality ranges from 32% to 55 %[2]. Of the total patients with ICH only 20 % of patients are expected to be functionally independent at the end of 6 months[2].

Risk Factors

There has been a rapid and remarkable 60% decline in death rates from stroke in the United States, and in most of the industrialized countries since 1972[5]. In addition, there is a striking decline in the incidence of intra-cerebral haemorrhage in Sweden[8]. This declining trend in case fatality rate of stroke in most industrialized countries may be explained by 3 mechanisms.

a. Improved acute stroke care which has prolonged survival.

b. Stroke cases in these places are less severe

c. Stroke cases that were mild in severity and previously undetected are being detected now[9].

This data serves to highlight the operation of environmental influences that are amenable to modification, and the intensity of effort and optimal utilization of public health resources to implement preventive measures might be the way for developing countries like India to deal with stroke.

This journey begins with assessing the changing risk factors which might predispose our population to the disease.

Untreated or under-treated hypertension is the single most important risk factor for spontaneous intracerebral haemorrhage (ICH)[3].

Spontaneous intracerebral haemorrhage is considered to be a predominantly a direct effect of chronic hypertension and the degenerative changes in the cerebral arteries[3]

Advanced **age** and heavy **alcohol** consumption are also known to be risk factors for ICH[2].

Pathogenesis

Hypertension causes a number of abnormalities in the vessel walls, including accelerated atherosclerosis in larger vessels; hyaline arteriosclerosis in smaller vessels and, in severe cases, proliferative changes and frank necrosis of arterioles. Arteriolar walls affected by the hyaline changes are presumably weak than are normal vessels and are therefore more vulnerable to rupture. In some instances, chronic hypertension is associated with the development of minute aneurysms, termed ***Charcot-Bouchard microaneurysms***, which might be the site of rupture. These aneurysms, occur in vessels that are less than 300 micro meter in diameter, most commonly in the basal ganglia, thereby making this the most common location of bleed[4]. However in few of the haemorrhages examined at autopsy with serial sections by C M fisher, the bleeding could not be traced to the aforementioned aneurysms[3].

Takebayaschi and co workers, in an electron microscopy study, found breaks in the elastic lamina at multiple sites, almost always at the bifurcation of the small vessels, possibly these represent sites of secondary rupture from tearing of small vessels by the expanding hematoma.[3]

The extravasated blood forms an oval mass that disrupts and compresses the adjacent tissue as it grows in volume. If the haemorrhage is large, midline structures are displaced to the opposite side and the reticular activating and respiratory centers can be compromised, leading to coma and death. In the first hours and days following the haemorrhage, a limited amount of oedema accumulates around the clot and adds to the mass effect. Hydrocephalus may occur as a result of bleeding onto the ventricular system or from compression of the third ventricle[3].

Clinical features

The presentation of the ICH, as elucidated earlier, sudden abrupt loss of consciousness progressing to coma or that of a less dramatic onset of focal neurological deficit, is determined by the size of the ruptured artery and the speed of bleeding[3].

A few clinical features which occur with a greater frequency in patients with intra-cerebral haemorrhage need special mention·

- **Acute reactive hypertension**, far exceeding the patient's chronic hypertensive level, is a feature that should always suggest haemorrhage; it is seen with moderate and large clots situated in deep regions.
- **Vomiting** at the onset of intra-cerebral haemorrhage occurs much more frequently than with infarction and should always suggest haemorrhage as the cause of an acute hemiparesis.
- **Severe headache** is generally considered to be an accompaniment of intra-cerebral haemorrhage, but in almost 50 percent of cases headache has been absent or mild in degree.

- **Loss of consciousness** is more often a feature of haemorrhage than infarct, though a significant number of haemorrhagic patients are alert at presentation.
- **Seizures**, usually focal, occur in the first few days in some 10 percent of cases of supratentorial haemorrhage, but more as a delayed event, months or even years after the event.
- Most of the haemorrhages develop over 30 – 90 minutes.[2] Thereby the patient might develop headache or vomiting, followed by sagging of the face in the next few minutes, followed by slurring of speech and then notice the arms and legs gradually weakening[3].
- In the majority of cases, the haemorrhage has its onset while the patient is up and active; onset during sleep is a rarity. However, haemorrhages may occur when the patient is calm and unstressed[3] .

Headache, acute hypertension, and vomiting with a focal neurologic deficit are therefore the cardinal features and serve most dependably to distinguish haemorrhage from ischemic stroke. Having said that, it must be noted that these prodromal symptoms do not occur with any consistency[3].

Types of intracerebral haemorrhage:

Putamen haemorrhage

This is the most common site of hypertensive bleed, and the adjacent internal capsule is usually damaged. Contralateral hemiparesis is therefore the sentinel sign. When haemorrhage is large, drowsiness gives way to coma, a dilated pupil and fixed ipsilateral pupil, and decerebrate rigidity.

Thalamic haemorrhages

They produce a contralateral hemiparesis due to extension into the adjacent internal capsule. A prominent sensory deficit involving all the sensory modalities is usually present. Thalamic haemorrhage, by virtue of its extension into the subthalamus and high midbrain, may cause a series of ocular disturbances.

Pontine haemorrhages

Here deep coma usually ensues in a few minutes, and the clinical picture is dominated by total paralysis, decerebrate rigidity, and small (1-mm) pupils that react to light. Lateral eye movements, evoked by head turning or caloric testing, are impaired or absent. Death usually occurs within a few hours, but there are rare exceptions in which consciousness is retained and the clinical manifestations indicate a smaller lesion in the tegmentum of the pons.

Cerebellar Haemorrhage

Repeated vomiting is a prominent feature, along with occipital headache, vertigo, and inability to sit, stand, or walk. In the early phase of the illness, other clinical signs of cerebellar disease may be minimal or lacking; only a minority of cases show nystagmus or cerebellar ataxia of the limbs, although these signs must always be sought. Dysarthria and dysphagia may be prominent in some cases but usually absent.

Diagnosis

The differentiation of acute stroke patients into infarcts and haemorrhage has perplexed physicians for years before the advent of CT scans. The symptoms preceding ictus were used to predict the diagnosis. Nuchal rigidity, if present would aid in diagnosis but only in cases where subarachnoid extension of bleed is present. Lumbar puncture was used to demonstrate the presence of red blood cells in the CSF and considered diagnostic[9].

A weighted clinical score was found to offer some advantages in distinguishing between haemorrhage and ischaemia for the purpose of treatment. Two of the popular scores are the **Allen score** from Guy hospital, London [33] and the **Siriraj Score** from Thailand.[34]

The parameters used in the two scores are essentially the same, including details of previous atherosclerotic diseases, symptoms associated with the ictus and presentation. The Allen Score is designed to be calculated only at the end of 24 hours of admission. The original studies had an accuracy of close to 88% in predicting the CT diagnosis for both the scores[34].

Numerous studies have tried the validation of these scores in various populations over the last 15 years in an attempt to arrive at a fairly reliable score to help differentiate the two types of strokes, but all with disappointing results as compared to the original results.

Badam et al in Indian settings found that both score are not sufficiently accurate to identify infarct from haemorrhage[43.] Kochar et al studied both the scores in an Indian setting and found that Siriraj stroke score had specificity of 73% and Allen's score had specificity of 91% in diagnosing haemorrhage[37]. Aomad Soman et al have shown similar results in the Indian settings[38].

Wadhwani Jyoti, et al showed that the sensitivity of Siriraj stroke score was 92.54% in diagnosing infarction and 87% for haemorrhage and its overall accuracy was 91.11%[44]. The Guy's hospital score had a sensitivity of

93.42% in diagnosing infarction, 66.66% for haemorrhage and overall accuracy of the score was 87%[44].

One conclusion universal to all the above mentioned studies with regard to the scores is that they are not infallible ,thereby underscoring that CT Brain is irreplaceable in the diagnosis of stroke subtypes.[38,37 36,40].

Computed Tomography

In the first clinical paper devoted to computed tomography published in 1973 by Ambrose, it said "in the overall investigation of cerebrovascular disease, computerized transverse axial scanning will, without doubt, come as an invaluable means of distinguishing infarcts and haemorrhages."[22]. In CT scans, fresh blood is visualized as a white mass (hyperdense) as soon as it is shed. The mass effect and the surrounding extruded serum and oedema are hypodense. After 2 to 3 weeks, the surrounding oedema begins to recede and the density of the haematoma decreases starting at the periphery. Gradually the clot becomes isodense with the brain.

CT imaging of the brain has proved to be totally reliable in the detection of haemorrhages that are 1.0 cm or more in diameter. Smaller pontine haemorrhages are visualized with less certainty. At the same time, coexisting hydrocephalus, tumor, cerebral swelling, and displacement of the intracranial contents are readily appreciated[3]

Predictors of Outcome

Intra-cerebral haemorrhage has been known as the stroke subtype with the highest case fatality rates from time immemorial.[7]

To identify the patients with a potential worse outcome would enable the treating team to anticipate and triage patients for stratifying care and prognosticate for the sake of clinical research and explaining the situation to the family.

Numerous parameters have been identified, some with consistent results in predicting outcomes, and others not so.

Age

Age has been reported to be a significant independent outcome predictor in some [13,14] but not the majority of previous studies. Age may appear important for several reasons. Younger patients tend to present to hospital sooner after ictus[13]; although no specific therapy has been demonstrated to have a significant effect on outcome in controlled trials, earlier treatment may reduce mortality.

Second, the elderly may not receive life-sustaining treatment as aggressive as that given to younger patients. Finally, age may serve as a proxy for other inter-current illnesses that might complicate the clinical situation.

Glasgow Coma Scale

The Glasgow Coma Scale (GCS) measures the best eye, motor and verbal responses, and is a widely used and accepted prognostic score for both traumatic and non-traumatic altered consciousness levels[18]. The score has been validated for its inter-observer reliability.[19]

The assessment of consciousness level in acute stroke is important for clinical management and as an indicator of prognosis. As stroke may cause localized motor, speech or language deficits, the accuracy of the GCS as a measure of consciousness level may be affected. In turn, its' prognostic value may be impaired.

Weir et al found that dysphasic subgroup showed that the verbal component provided additional prognostic information to the combined eye and motor scores[17]. When a language disorder is absent, the verbal score contributes prognostic information by measuring level of consciousness or by acting as a marker for confusion[17]. Thereby, the GCS score might retain independent outcome predictor value in stroke patients, it's utility increased if combined with the other stroke predictors[17].

The National Institutes of Health Stroke Scale (NIHSS)

The NIHSS is a 15-item neurologic examination stroke scale used to evaluate the effect of acute stroke on the levels of consciousness, language, neglect, visual-field loss, extraocular movement, motor strength, ataxia, dysarthria, and sensory loss and thereby quantify accurately the neurological deficitThere is an allowance for items which cannot be tested in a patient. [28]. The scale is widely used as a clinical assessment tool to evaluate acuity of stroke patients, determine appropriate treatment, and predict patient outcome[29].

Computed tomography findings

With the advent of CT scanning, estimations of the **volume** of intra-cerebral haemorrhages were possible which lead to numerous studies, which confirmed a positive correlation between increasing volume of bleed and worsening outcome[22,27]. Kothari et al then went to on devise a simple technique to estimate the volume of bleed by using the formula for volume estimation of an ellipsoid[24]. The volume as estimated by the above technique has been validated to be accurate and quick to use[23]. **Expansion of the haematoma** as a complication has been noted to have a graver prognosis[25]

Tuhrim S et al noted that **intra-ventricular extension** of a bleed in a supra-tentorial location was associated with worsening of prognosis[27]. This finding was confirmed by a few other studies as an independent predictor of outcome[15].

Infra-tentorial location of the bleed has been identified as a potential predictor of poor outcome, due to the increased chances of obstructive hydrocephalus and brainstem involvement[17,26].

Outcome predictor scores

Most of these independent variables which predicted outcome in ICH patients were noted to have greater significance of correlation on combination as assessed by multivariate analysis. This led to formulation and validation of a series of scores with varying permutations of the above mentioned variables. One of the earliest and one that has stood the test of time is the **Intra-Cerebral Haemorrhage(ICH) score** as conceived by J Claude Hemophill et al[15].

Based on the strength of independent association of the specified parameters, points were assigned and a stratification scale designed. The total ICH Score ranges from 0 to 5 and the 30 day mortality of each of the scores was found to have a linear correlation with the score[15].

A number of studies following this study have validated the score including the one by Fernandes[30] et al, Cheung et al[32] and Ruiz Sandovol et al[31].

Ruiz Sandovol et al found that different cutoffs values for the variables in the scoring improved substantially the prognostic power of the predictors included in the ICH score, and designed the **Intra Cerebral Haemorrhage Graded Scale (ICH-GS)**. It explained more variance in the outcome measures, had higher sensitivity in predicting in-hospital and 30-day mortality, and performed equally well in predicting good functional outcome at 30 days follow up.[31]

In a country like ours, where health care is still a luxury, identifying and rectifying the risk factors would be right on top of the priority list. Secondly, C T scans are inaccessible in many parts of the country, hence the quest to device or validate a scoring system which can accurately help decide between haemorrhage and infarct in stroke patients continues. Last, intensive medical care resources are available in only a handful of tertiary referral centers, hence the need to validate a risk stratification score which might help optimal utilization of the available resources.

MATERIALS AND METHODS

Setting	**:**	In-patients department, Institute of Internal Medicine, Government General Hospital, Madras Medical College, Chennai.
Ethical committee Approval	**:**	Obtained
Design of study	**:**	Single center, descriptive study
Period of study	**:**	January 2007 – March 2008.
Sample size	**:**	150 patients.

Selection of study subjects

Inclusion criteria:

Patients with Spontaneous

Intracerebral Haemorrhage.

Exclusion criteria :

Patients on thrombolytics, anti-coagulants,

Traumatic haemorrhage,

Venous infarct with hemorrhagic

Transformation,

Aneurysmal bleeding.

Methodology :

The study was carried out in the wards of the Institute of Internal Medicine, Government General Hospital.

Patients with Spontaneous Intracerebral Haemorrhage as confirmed by computed tomography of the brain were selected. A total of 150 patients were included as per the selection criteria. They were enrolled into the study after informed consent was obtained from the patients and from the closest relative in case of patients in altered sensorium.

Patients' demographic, social, economic and medical details were recorded in the proforma sheet. Information regarding the symptoms preceding the present illness were recorded as well.

The initial assessment on admission included assessment of level of consciousness using the **Glasgow Coma Scale (GCS)** table {appendix}, blood pressure measurement, neurological deficit assessment using **the National Institute of Health Stroke Scale (NIHSS)** table 2{appendix}.

The **Intra Cerebral Haemorrhage (ICH) Score** and the **Intra Cerebral Haemorrhage Grading Scale (ICH-GS)** (table 3) were calculated.

The Siriraj score (table 4) was calculated using details of the clinical presentation on admission and the **Guy Allen score** (table 6) was calculated 24 hours after admission to differentiate patients into the subtypes of strokes.

Computed Tomography (CT) Scanning of the Brain was studied to record the location of the bleed, presence of intraventricular extension. The volume of the bleed was calculated using the ABC/2 technique.

The **bedside ABC/2 method**, the CT slice with the largest area of haemorrhage was identified. The largest diameter (A) of the haemorrhage on this slice was measured. The largest diameter 90 degrees to A on the same slice was measured next (B). Finally, the approximate number of 10-mm slices on which the ICH were seen was calculated (C). C was calculated by a comparison of each CT slice with haemorrhage to the CT slice with the largest haemorrhage on that scan. If the haemorrhage area for a particular slice was greater than 75% of the area seen on the slice where the haemorrhage was largest, the slice was considered 1 haemorrhage slice for determining C. If the area was approximately 25% to 75% of the area, the slice was considered half a haemorrhage slice; and if the area was less than 25% of the largest haemorrhage, the slice was not considered a haemorrhage slice. These CT haemorrhage slice values were then added to determine the value for C.

All measurements for A and B were made with the use of the centimeter scale on the CT scan to the nearest 0.5 cm. A, B, and C were then multiplied and the product divided by 2, which yielded the volume of haemorrhage in cubic centimeters.

The patient was followed up during the stay in the hospital and evaluated for presence of co-morbid illnesses and development of in-hospital complications.

Outcome was evaluated on the day of discharge (or earlier in case of death) and functional disability graded using the **Modified Ranking Scale (**MRS) table 6. This score assesses functional independence and impact on activities in daily living and grades patients from 0 (no symptoms) to 6 (death). In the study a score more than 4 is taken as poor outcome and a score lesser than or equal to 4 as good outcome.

The data thus obtained were analysed with the help Microsoft Excel 2003 and the statistical analysis using Statistics Package for Social Sciences (SPSS 12).

RESULTS

Gender:

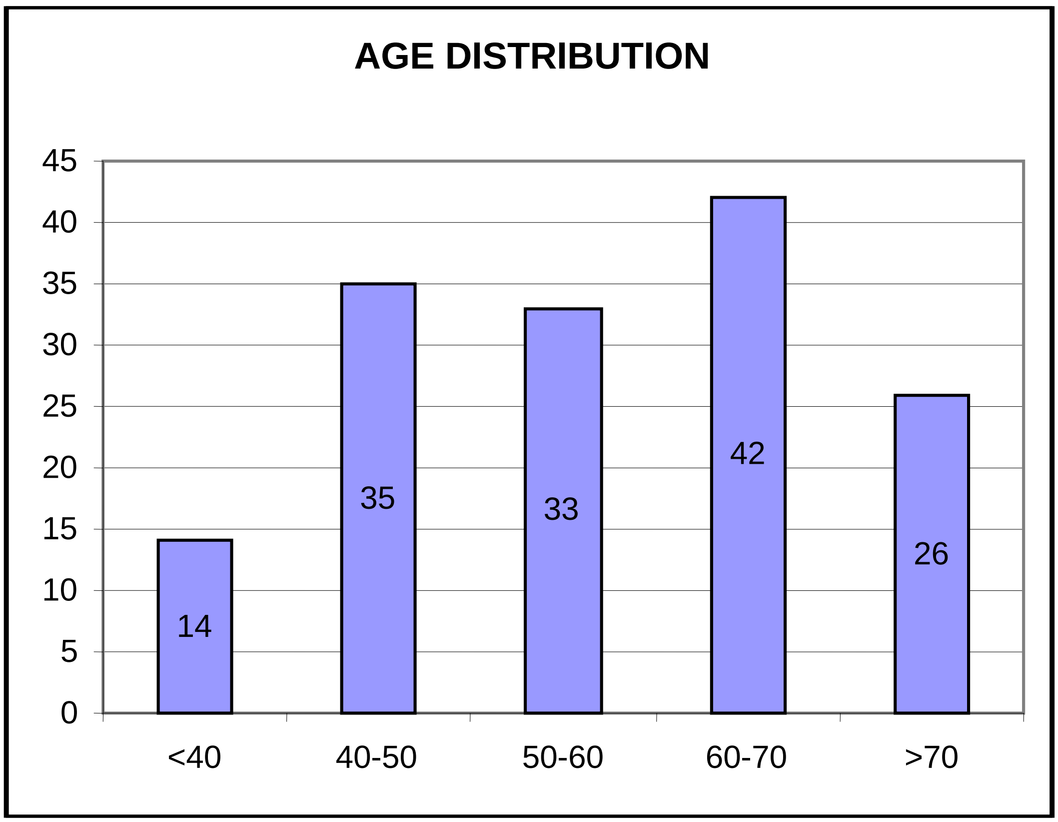
In the study group, 76 % were male and 24 % were female. On comparing gender and outcome in the form of Modified Ranking Score MRS { < 4 (good), > 4 (bad) }, no statistically significant association was found between gender and outcome in intracerebral haemorrhage.

Modified Ranking score

	≤ 4 (good)	**>4 (bad)**	**P Value**
Male	52 (45.6%)	62 (54.4%)	**0.252**
Female	12 (33.3%)	24 (66.6%)	

Age:

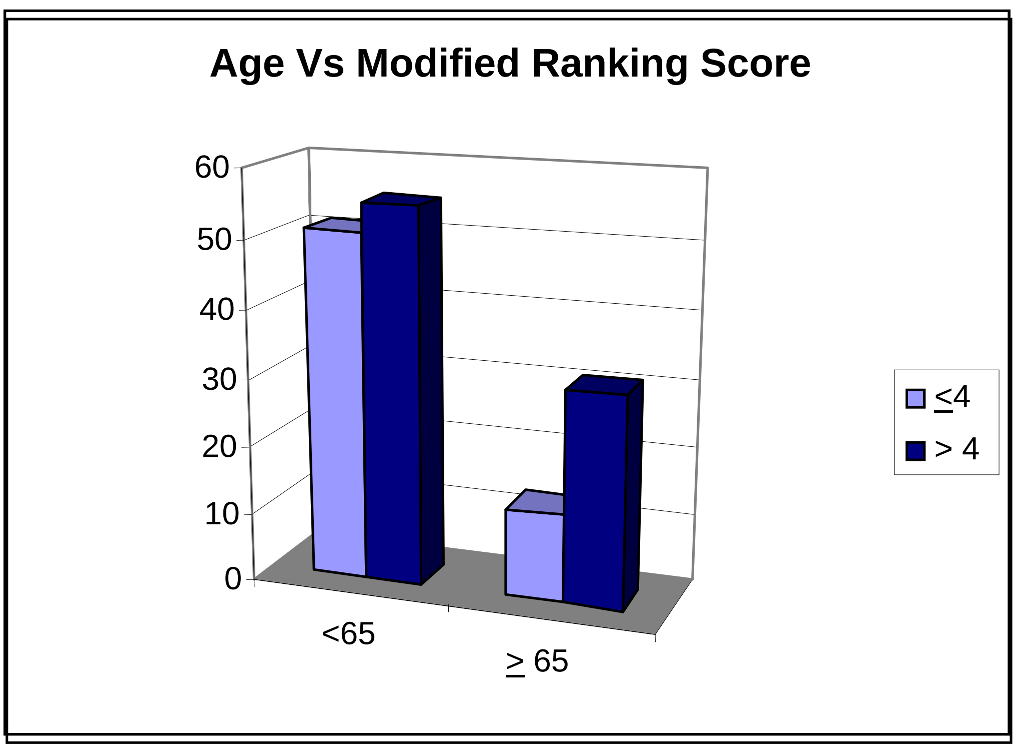
The age of patients in the study ranged from 25 years to 85 years with a mean of 55.9 years. The mean age of the female patients was 61.7 yrs and that of male patients 54.3 yrs.



On comparison of age with the outcome as assessed by the Modified Ranking Score (MRS), a statistically significant positive correlation was found.

Modified Ranking score

Age	≤4 (good)	>4 (bad)	P Value
<65	51(48.1%)	55 (51.9%)	**0.036**
≥65	13 (29.5%)	31(70.5%)	

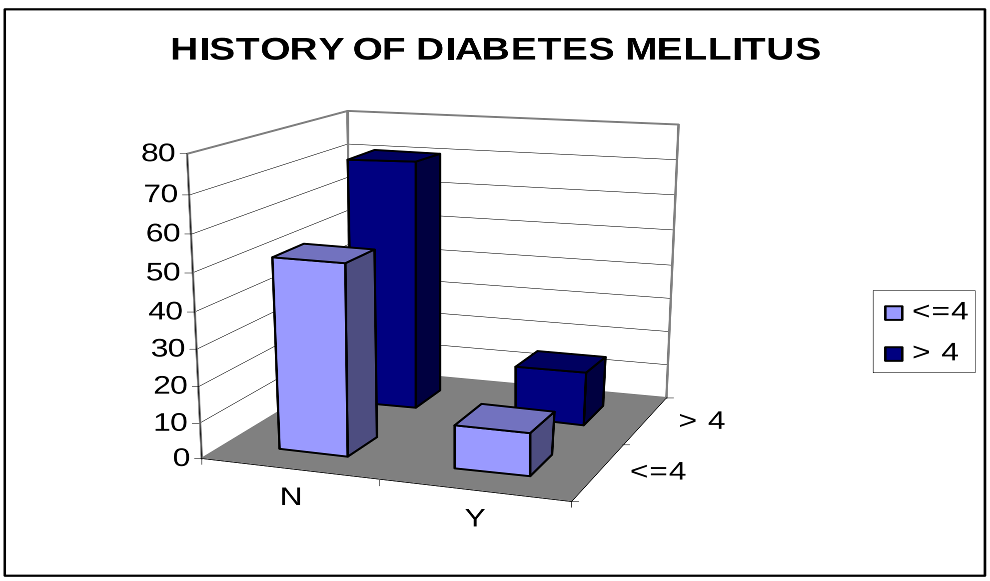


History of Diabetes Mellitus:

History of Diabetes Mellitus was obtained in 27 patients accounting for 18 % of the group. On comparison, no statistically significant co-relation was obtained between the history of Diabetes Mellitus and the outcome.

Modified Ranking score

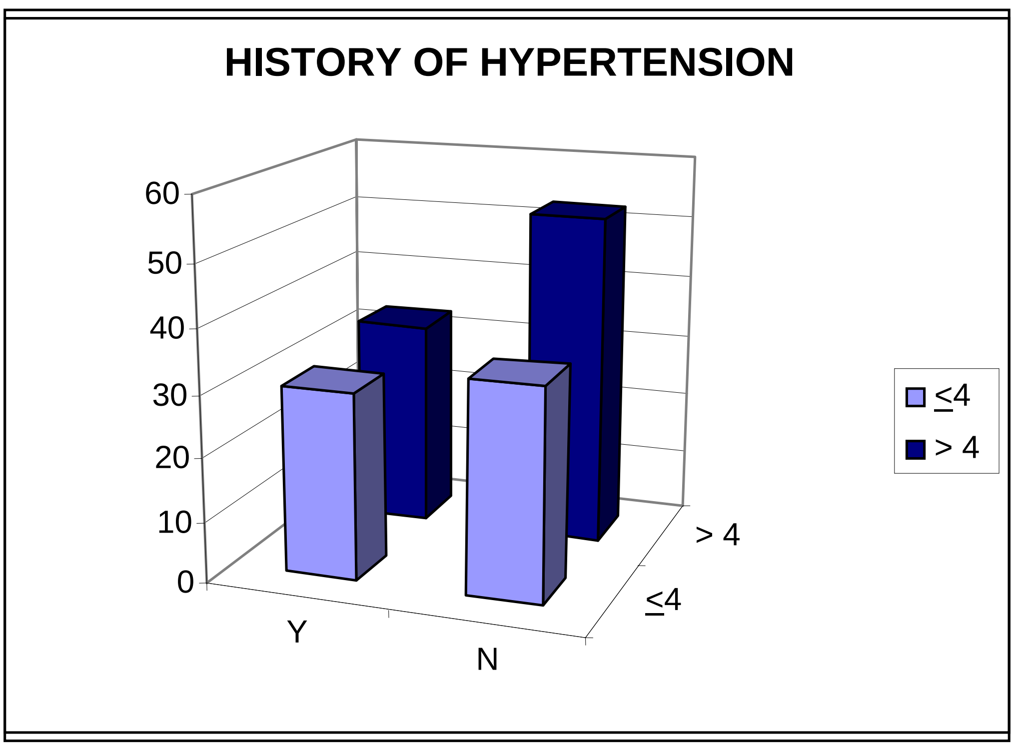
DM	≤4 (Good)	>4 (Bad)	P Value
Yes	12 (44.4%)	15 (55.6%)	0.836
No	52 (42.3%)	71 (57.7%)	



History of Hypertension:

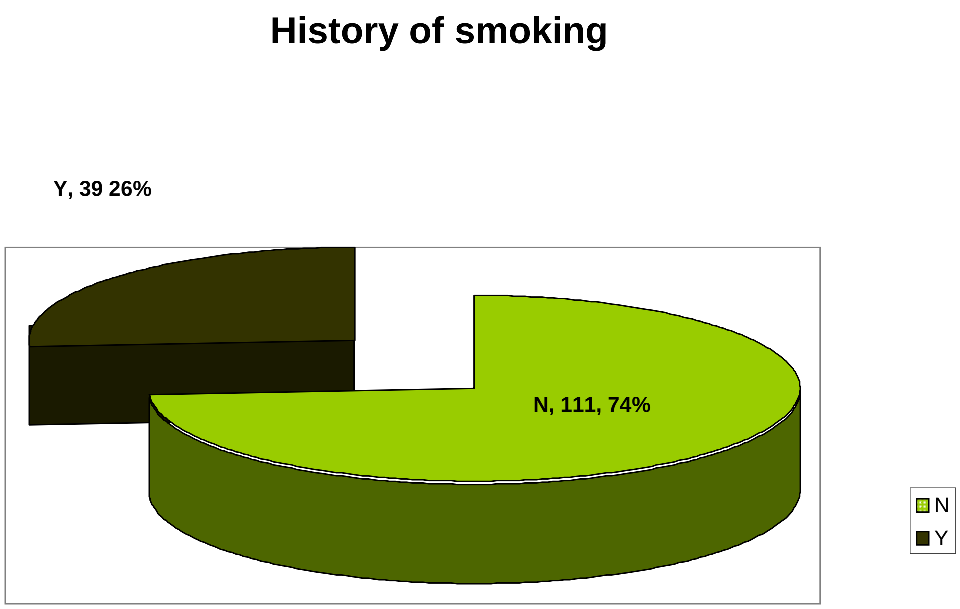
63 of the 150 patients gave a history of hypertension accounting for 42 % and this was not associated with a statistically significant correlation with outcome.

HTN	≤4 (Good)	>4 (Bad)	P Value
Yes	30 (47.6%)	33 (52.4%)	0.296
No	34 (39.1%)	53 (60.9%)	



Smoking:

39 of the 150 patients in the study were smokers (26%). History of smoking was not found to correlate with the outcome of patients with intracerebral haemorrhage.

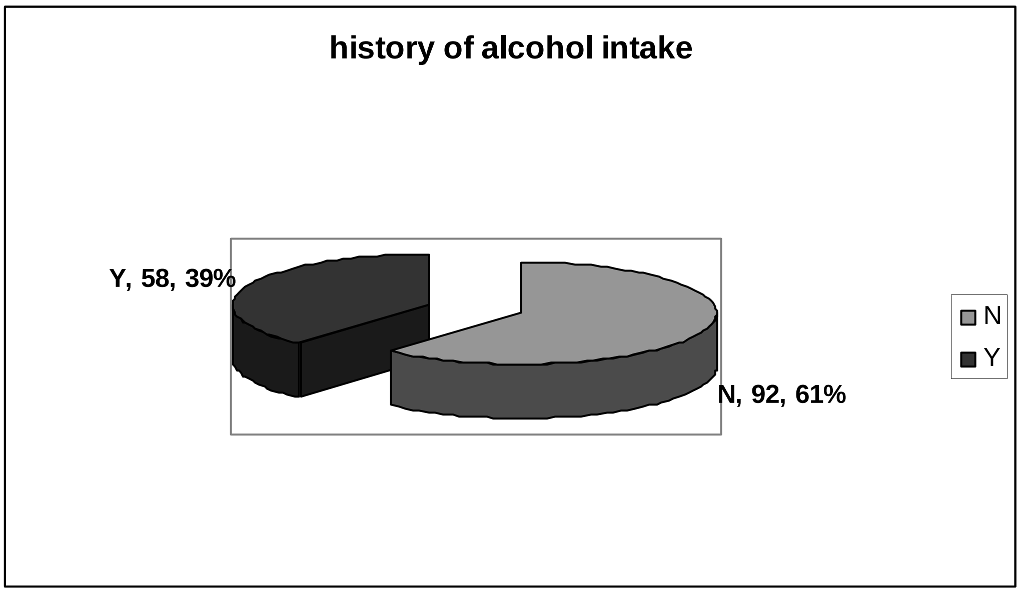


Modified Ranking Score

Smoking	**≤4 (good)**	**>4 (bad)**	**P value**
Yes	19 (48.7%)	20 (51.3%)	**0.374**
No	45 (40.5%)	66 (59.5%)	

***Alcohol intake*:**

58(38.7%) of the 150 patients had a history of alcohol intake. On comparing this information with the outcome, no statistically significant correlation as found.



Modified Ranking Score

Alcohol	≤4 (good)	>4 (bad)	P Value
Yes	28 (48.3%)	30 (51.7%)	**0.270**
No	36 (39.1%0	56 (60.9%)	

***Other illnesses*:**

Other co-existent illnesses were identified in 17 (11.7%) of the 150 patients. There was no statistically significant correlation with the presence of these illnesses with the outcome.

Illness	No.
Chronic kidney disease	**10**
Stroke	**3**
Pulmonary TB	**2**
Coronary artery disease	**2**
Coarctation of aorta	**1**

Modified Ranking Score

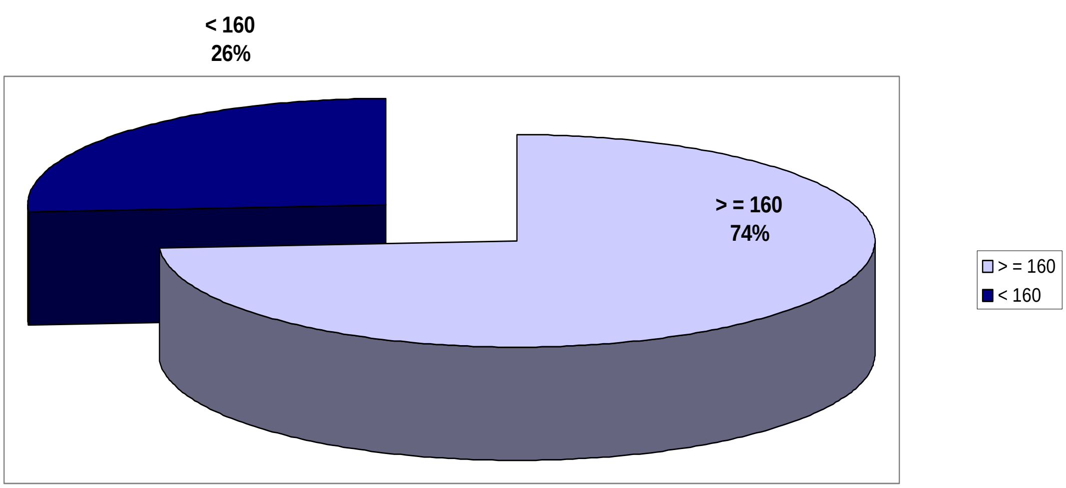
Illness	≤4 (good)	>4 (bad)	P Value
Yes	10 (58.8%)	7 (41.2%)	**0.152**
No	54 (40.6%)	79 (59.4%)	

Systolic blood pressure:

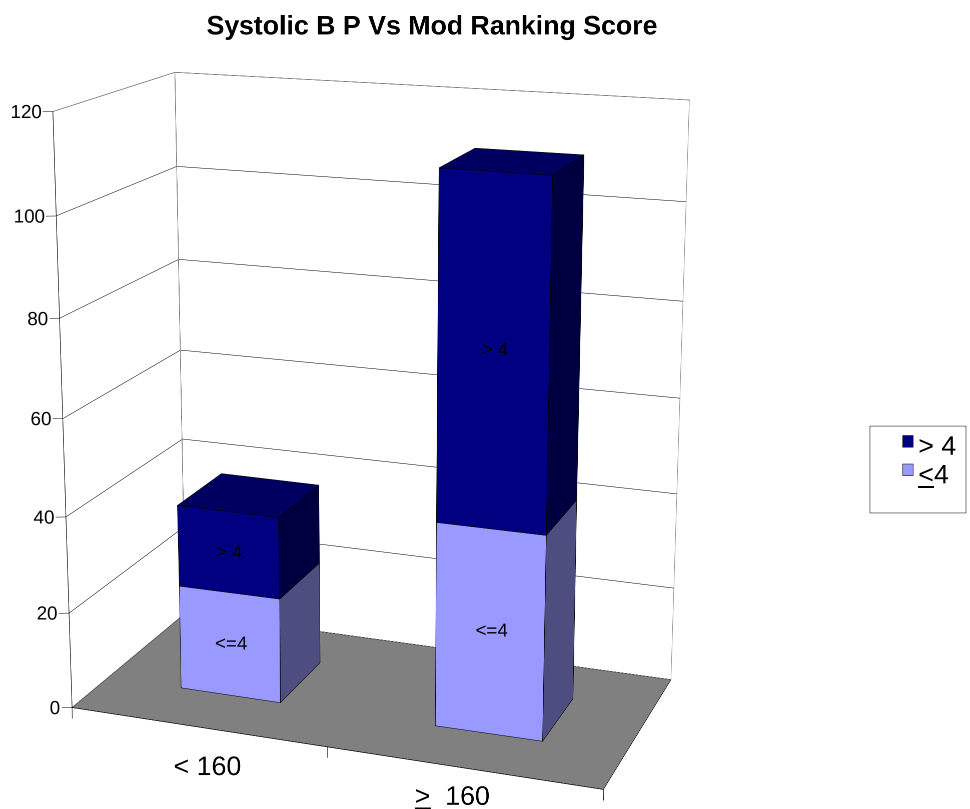
The systolic blood pressures measured on admission was found to be in the range of 110 - 260 mm of Hg with a mean value of 176 mm Of Hg.

The systolic blood pressure was elevated to beyond 160 mm of Hg is 111 (74 %) of patients.

Systolic B P distribution



On comparing the systolic blood pressure readings with the outcome and analyzing using the Chi square test, a significant positive correlation as found.



<u>Modified Ranking Score</u>

Sys BP	≤4	>4	P value
<160mm of Hg	22 (56.4%)	17 (43.6%)	**0.04**
>160 mm of Hg	42 (37.8%)	69 (62.2%)	

Diastolic blood pressure:

The range of diastolic blood pressure in the study was from 30 – 190 mm of Hg with a mean value of 104 mm of Hg. The diastolic pressure was above 100 mm of Hg in 113 (75.3%) of patients.

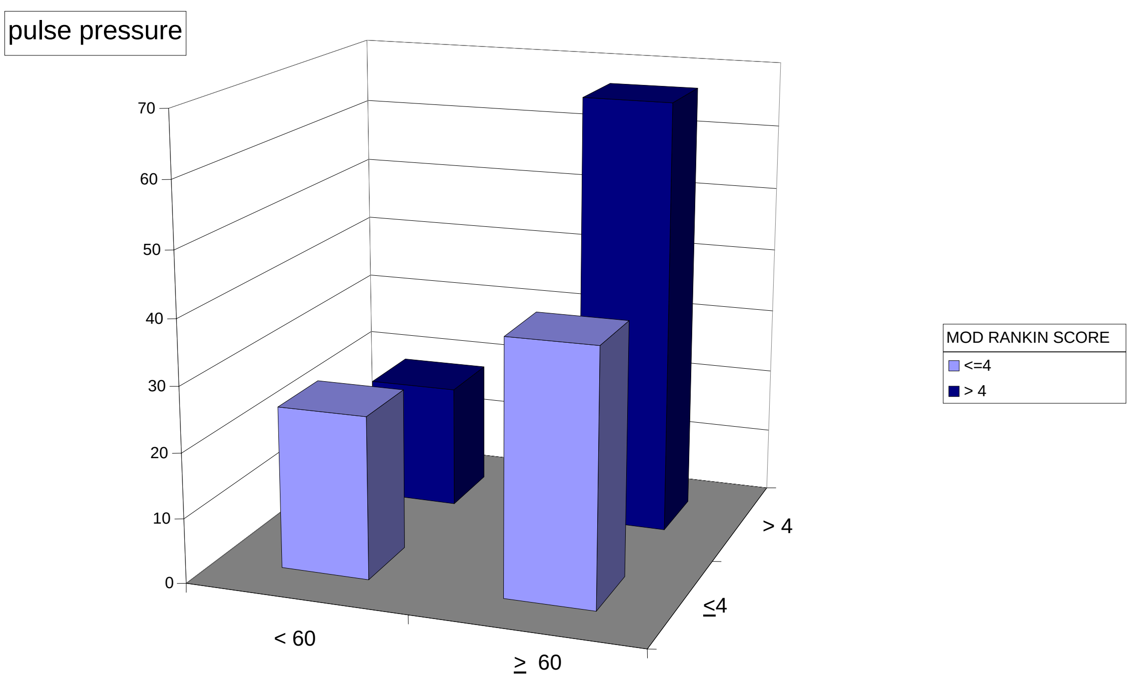
On comparing diastolic blood pressure and outcomes using the Chi square test, no statistically significant correlation was obtained.

Diastolic B P	≤4 (Good)	>4 (Bad)	P value
<100 mm of Hg	13(35.1%)	24(64.9%)	**0.285**
≥100mm of Hg	51(45.1%)	62(54.9%)	

Pulse pressure:

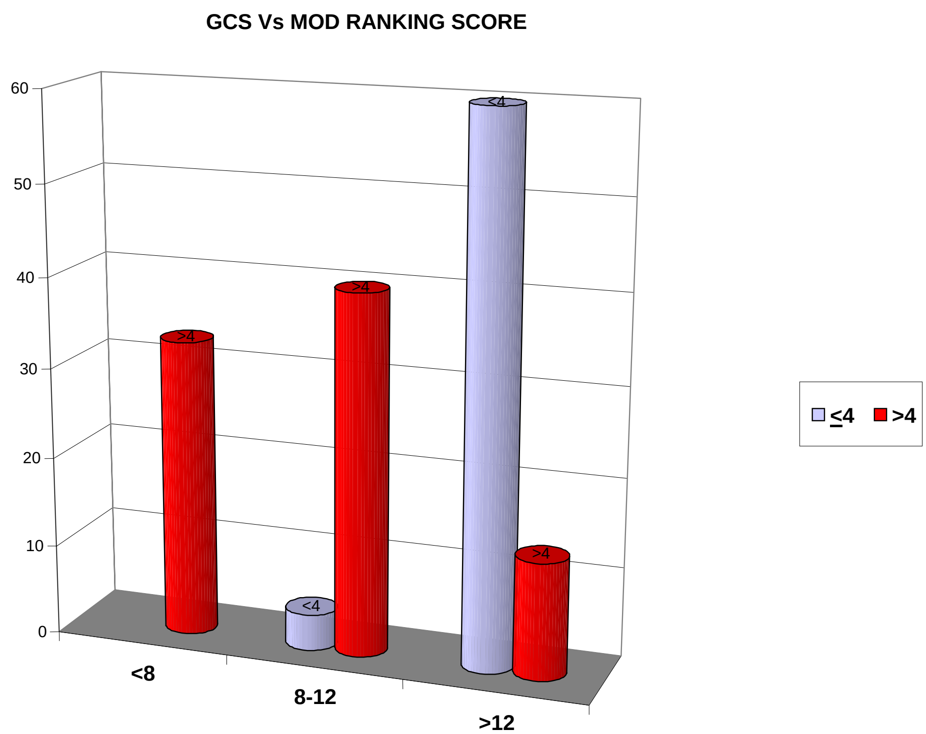
A significant positive correlation was found between pulse pressure and outcome on analysis using the Chi square test.

Pulse pressure	≤4 (Good)	>4 (Bad)	P value
<60	24(55.8%)	19(44.2%)	**0.03**
≥60	40(37.4%)	67(62.6%)	



Glasgow Coma Scale:

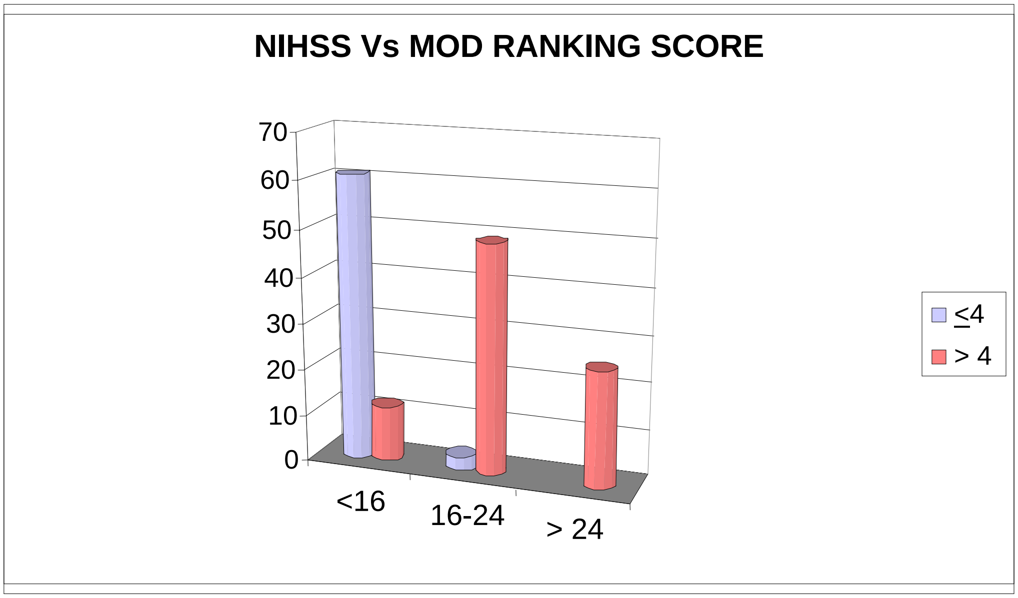
The Glasgow Coma Score was used to ascertain the level of consciousness on admission and was graded as per severity. A highly significant positive correlation was obtained between the GCS on admission.



GCS	<8	8-12	>12	P Value
≤4 (good)	0	4(8.9%)	60(83.3%)	**<0.001**
>4 (bad)	33(100%)	41(91.1%)	12(16.7%)	

National Institute of Health Stroke Scale (NIHSS):

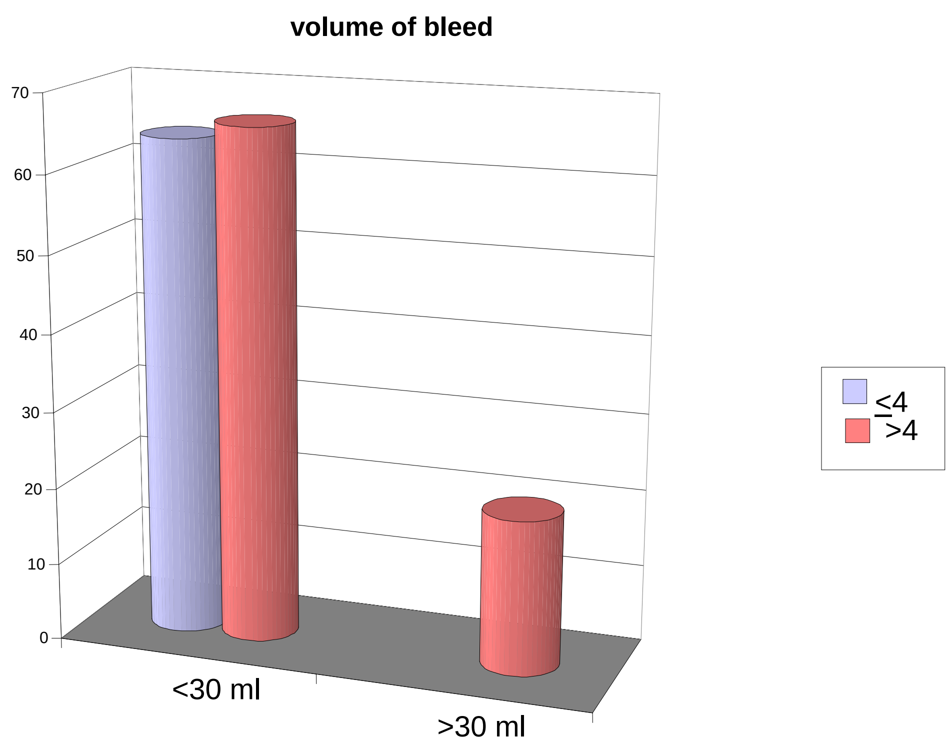
The NIHSS was used to assess the neurological deficit on admission and was graded into 3 categories and compared with outcome. The association between increasing NIHSS score with worsening outcome was highly significant as assessed by the Chi square test.



NIHSS	<16	16-24	>24	P value
≤4 (good)	61(83.6%)	3(5.8%)	0	**<0.001**
>4 (bad)	12(16.4%)	49(94.2%)	25(100%)	

Volume of intracerebral haemorrhage:

The volume of the bleed as calculated by the ABC/2 method from the CT scan ranged from 0.22ml to 96 ml with a mean value of 5.25 ml. The correlation between increasing volumes of bleed with worsening outcome was found to be highly significant statistically.



Volume	<30ml	>30 ml	P value
≤4(good)	64(50%)	0	**<0.001**
>4(bad)	64(50%)	22(100%)	

***Location of the Bleed*:**

4(2.7%) of the 150 patients had a infra-tentorial site of bleed as compared to the majority of 146(97.3%) with a supra-tentorial bleed.

No statistically significant correlation was found between the site of bleed and outcome.

Modified Ranking score

Location	**≤4(good)**	**>4(bad)**	**P value**
Supra-tentorial	61(41.8%)	85(58.2%)	**0.185**
Infra-tentorial	3(75%)	1(25%)	

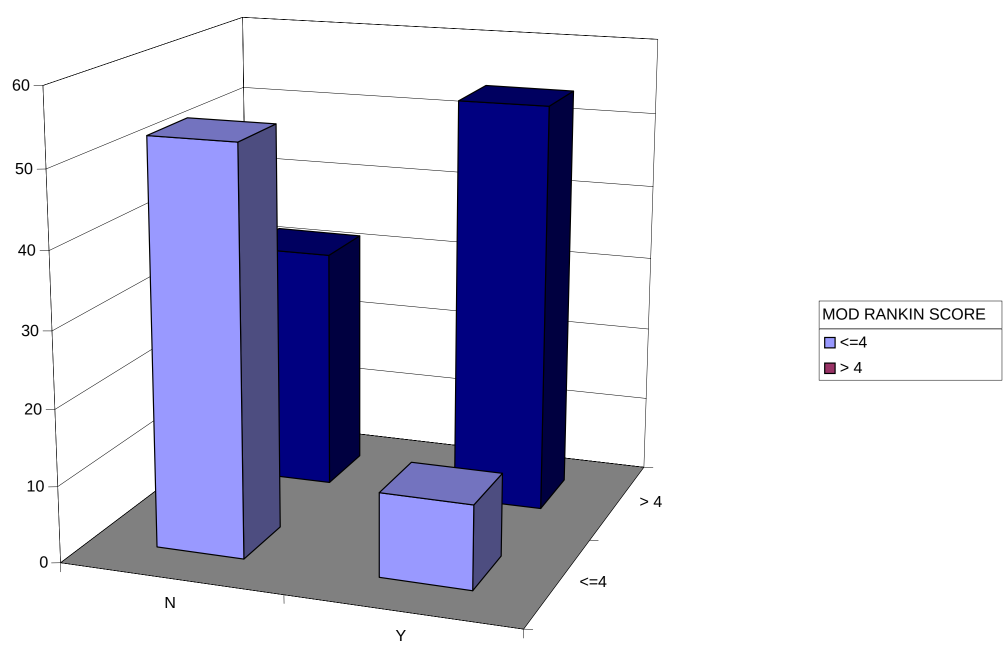
Intraventricular extension of bleed:

65 of the 150 patients (43.3%) had an intraventricular extension of the bleed. All the patients with intraventricular extension of the bleed had a statistically significant worse outcome on the Modified Ranking Score.

Modified Ranking Score

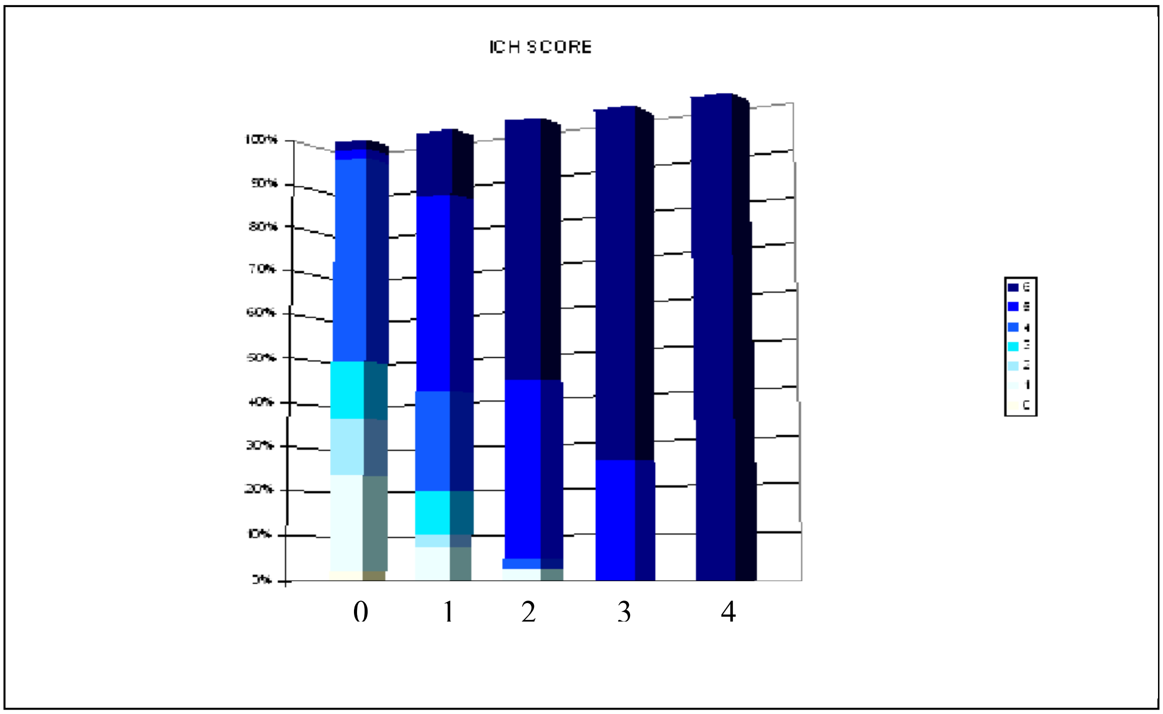
IVH	**≤4(good)**	**>4(bad)**	**P value**
Yes	11(16.9%)	54(83.1%)	**<0.001**
No	53(62.4%)	32(37.6%)	

Intraventricular extension



<u>The ICH score:</u>

The Intra Cerebral Haemorrhage (ICH) score was calculated for each of the patients and was compared with the outcome as measured by the modified Ranking Score on the day of discharge to reveal a statistically significant correlation between increasing score and worsening outcome.



Outcome

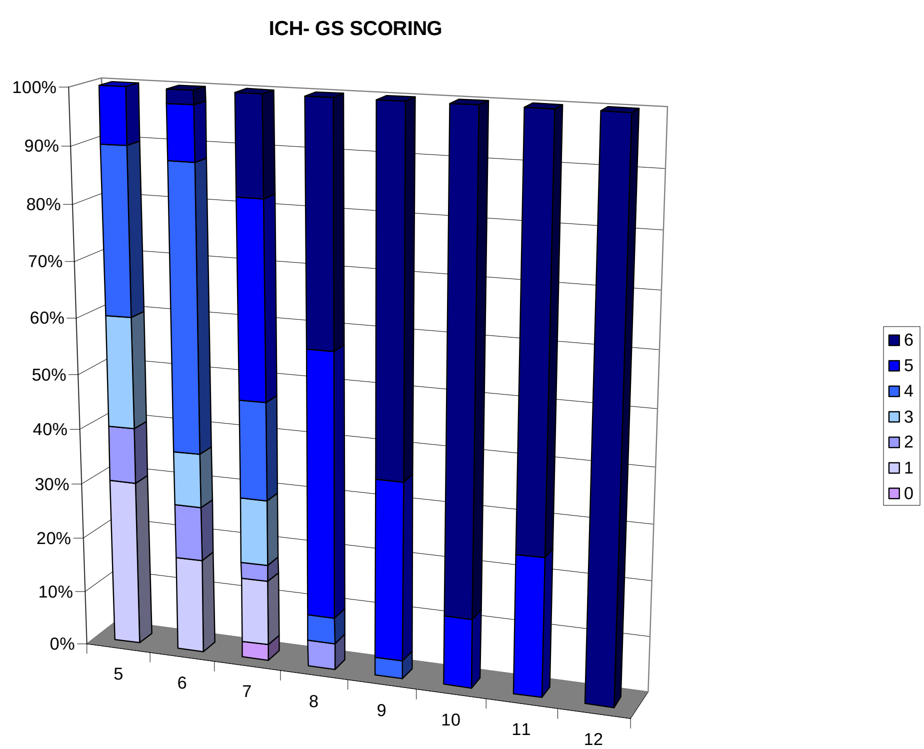
ICH score	≤4(good)	>4(poor)	P value
0	45(95.7%)	2(4.3%)	**<0.001**
≥1	19(18.4%)	84(81.6%)	

The Intra Cerebral Haemorrhage - Grading Scale(ICH-GS):

The ICH-GS scoring was calculated on the admission day and was compared with the outcome on the day of discharge to reveal a positive statistically significant correlation with the increasing score and the worsening outcome.

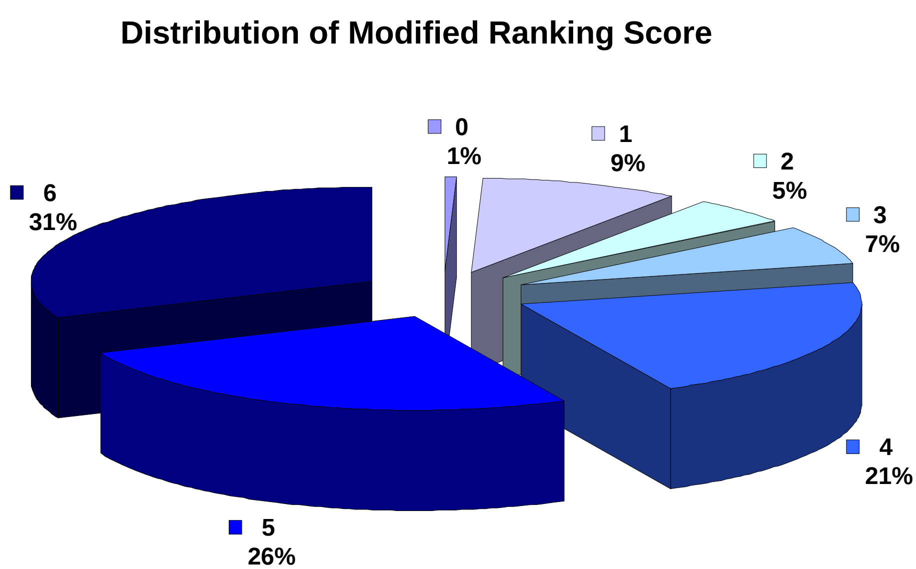
Modified Ranking Score

ICH-GS	≤4(good)	>4(bad)	P value
≤6	45(88.2%)	6(11.8%)	**<0.001**
>6	19(19.2%)	80(80.8%)	



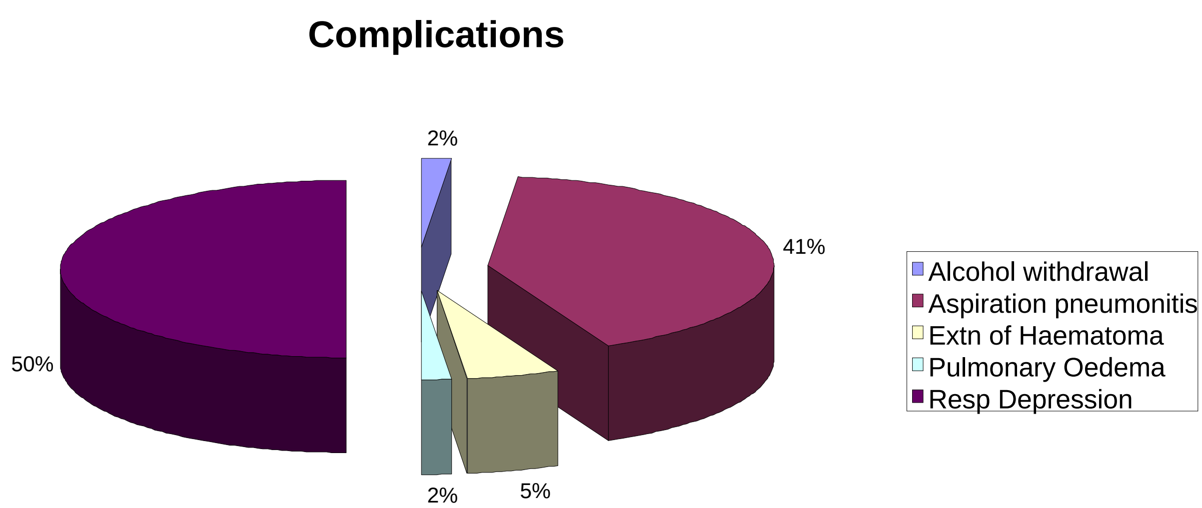
Outcome:

The patients were evaluated on their last day in the hospital for the outcome using the Modified Ranking Score based on the functional ability and graded from 0 (no disability) to 6 (death) with increasing disability on the scale



Complications:

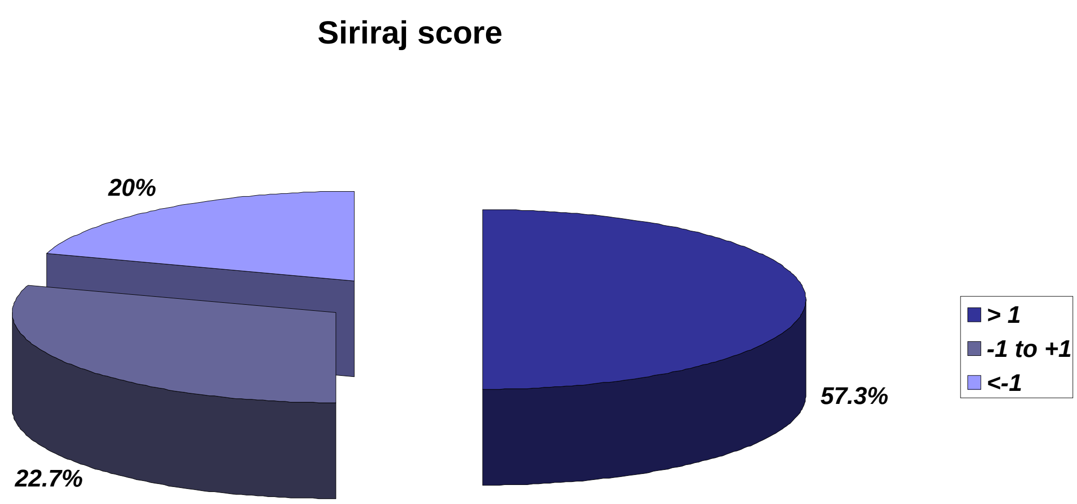
The most common cause of death was respiratory depression, followed by aspiration pneumonitis which occurred in 41 % of patients who developed complications



Siriraj score :

The Siriraj score was calculated at the time of admission. It was found that the score predicted haemorrhage with an accuracy of 50% in this study.

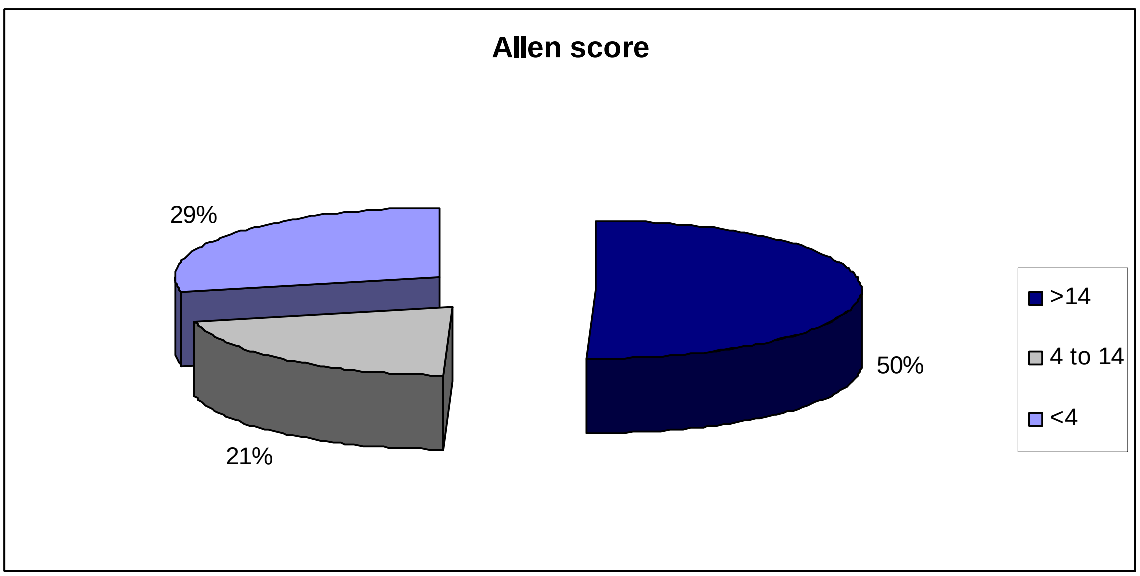
Siriraj score	**No of patients**
> 1(haemorrhage)	75(57.3%)
1 to -1(equivocal)	45(22.7%)
<-1(infarct)	30(20%)



The Guy Allen Score:

Using the clinical features and symptoms, the Guy Allen score was calculated 24 hours after admission and used to stratify patients into haemorrhage (>+14), infarct (<+4) or equivocal.

Allen's score	No of patients
>14	76(50.6%)
14-4	33(20.8%)
<4	43(28.6%)



DISCUSSION

Clinical profile:

Age & gender

The mean age of patients in the study group was found to be 55.9 yrs , slightly higher in the females (61.7 yrs) than the males (54.3 yrs). The increasing incidence of stroke with increasing age has been demonstrated convincingly by the Framingham study[9]. In this study, an increasing trend was noticed in the age group of 45 to 63 years for both the males and the females. A decreasing slope was noticed in the incidence in ICH in the age group over 65 yrs and this might be attributable to the smaller subset of this population as the average life expectancy of the Indian population is around 63 years, a finding akin to that of the Framingham study[9].

The ratio of male to female patients was 2:1. This is in contrast to the findings of the Framingham study where equal distribution was found between the two sexes. This might be partly explained by the fact that medical attention is sought more often in the male patients than the female patients in our country.

History of Hypertension and Diabetes Mellitus

42% of the patients had a history of hypertension with more than two thirds of the hypertensive patients on irregular treatment. Another 10% of the non hypertensive patients had electrocardiographic evidence of left ventricular hypertrophy (LVH), which is a surrogate marker of chronic hypertension.

Though Hypertension is the single most important risk factor for intracerebral haemorrhage[2,3], evidence for it's presence was found only in around 50% of patients. The presence of hypertension prior to the ictus could not be ruled out in the remaining 50% of patients and hence the emphasis on periodic blood pressure measurements is highlighted.

Though Diabetes Mellitus hasn't been known directly as a risk factor for ICH, it has been noted to be a known to increase the risk of a stroke in patients who might be hypertensives[1], Arboix et al identified history of Diabetes Mellitus as an independent predictor of worse outcome[45].

Habits and co-morbid illness

History of ingestion of >60 g of alcohol was obtained in 38.7% and history of smoking on 26% of patients. Though history of alcohol intake is known to be a predisposing factor in intracerebral haemorrhage, it's presence in less than 40% of patients might be due to the socio-cultural factors which might force patients or patients' care takers from withholding this information to medical personnel.

70% of patients had a history of exertion immediately before ictus most of them being involved in activity demanding mild to moderate exertion.

11.7% were found to have other co-existing illnesses of which the most common was chronic kidney disease closely followed by previous history of stroke.

Blood pressure, GCS and NIHSS Score

Systolic blood pressure was found to be elevated to more than 160 mm of Hg is more than 74% on the day of admission and persistently elevated in 70% of the patients in the following 24 hours. This might not be representative of all the hypertensive patients in the study group as the phenomenon of acute reactional hypertension is a recognized event in the acute settings of ICH[3]. Nevertheless, the need for monitoring hypertension till the day of discharge and appropriate treatment is imperative.

The level of consciousness as assessed by the Glasgow Coma Score showed that 48%, 45% and 22 % of patients had a score of >12, 8 – 12 and <8 respectively.

The neurological status as assessed by the NIHSS revealed that showed a significant neurological deficit in over 65% of patients.

CT findings and mortality

Most of the patients had a supratentorial location of bleed, with only 4 of the patients having an infratentorial bleed.

Intraventricular extension of the parenchymal bleed was noticed in 43.3% of the patients.

The volume of bleed as assessed by the ABC/2 method was found to range from 0.22 ml to 96 ml with an average volume of 15 ml.

The outcome of the intracerebral haemorrhage as assessed by the modified Ranking Score showed a mortality rate of 31%, severe to moderate disability in 47% and mild disability in the remaining patients. The mortality rate for intracerebral haemorrhage is between 32 – 50%[2,3], though in this study group the mortality rate was noticed to be 31%. This could possibly be explained by the fact that a significant proportion of severely disabled patients went home against medical advice thereby the eventual course could not be followed up.

Cause of Death

The most common cause of death was noted to be **respiratory depression** which was usually manifest by the first 48 hours. The second most common cause of death was **aspiration pneumonitis**. **Extension of haematoma** was identified in 3 patients with worsening of sensorium as the clinical manifestation. This complication might have been underestimated in this study as repeat CT scans were taken only in those patients in whom this complication was strongly considered and not the others due to financial constraints.

Siriraj score and Guy Allen score

In this study, Siriraj score of > + 1, suggestive of haemorrhage was seen in only 86 out of 150 patients (57.3%). In 37 patients, the score predicted an infarct with a cutoff value of < - 1 (24.6%). The score was equivocal in about 15 % of patients.

The Allen score , with a cut off value of >14 for haemorrhage, 76 out of 150 patients (50.6%) were identified. In 43 out of 150 patients (28.6%), the score was < 4 indicative of an infarct. And in the other 33 patients (20.8%) the score was equivocal.

Thus the Siriraj score and the Allen score, could correctly identify haemorrhages based on clinical scenario in 57.3% and 50.6% respectively. Combination of the above two scores did not have a better result. The chances of incorrectly identifying haemorrhagic patients as having infarcts were 24.6 % for Siriraj score and 28.6% in the Allen score.

These findings are akin to those of the studies conducted in India by Kochar et al[37] though there are numerous studies with findings of accuracy of over 70%[46,34].

Predictors of Outcome:

All the variables discussed above were tallied with the outcome as assessed by the modified Ranking Score to reveal the following details.

Age

Age has been identified to be a predictor of worse outcome in a few studies [13, 14] and less consistently in the other studies. In this study, age was identified to be a highly significant independent predictor of worse outcome. The cut off value of age > 80 yrs has been used by Claude Hemphill et al [15], a lower cut off for age would seem more appropriate for an Indian population with an average life span of 64 years. Thereby, age > 65 yrs was used and was found to have highly significant correlation in predicting worse outcome.

GCS and NIHSS Score

GCS score has consistently been found to have a positive correlation in worse outcome in patients with stroke despite the shortcomings faced in a dysphasic patients[17, 20]

In this study GCS was identified to have a high significant correlation **($p< 0.001$)** with worsening outcome both independently and as a part of the Intra Cerebral Haemorrhage (ICH) Score.

National Institute of Health Stroke Scale (NIHSS) was used to assess the neurological deficit and this was correlated with the outcome to yield a highly significant correlation **($p<0.001$).**

Thus, both GCS and NIHSS scores can independently predict outcome after a haemorrhagic stroke.

CT findings

Volume of intra-cerebral haemorrhage, has been consistently shown to have a positive correlation especially in the supra-tentorial bleeds[22, 27, 26.]

The **volume of bleed**, on comparison to the functional outcome revealed a highly significant positive correlation (**$p<0.001$**). Extension of haematoma was noted in 3 patients and as associated with a 75% mortality rate akin to the study done by Fliboutti J J et al[25].

Intra-ventricular extension of the bleed was noted in 43.3% of the patients and 83% of these patients were found to have a poorer prognosis on follow-up. This finding was also noted to have a highly significant correlation with outcome (**$p<0.001$).**

Infra-tentorial location of the bleed was noted in four patient accounting for 0.02%. Though this location of a bleed has been traditionally identified with a worse prognosis, this finding was offset in this study due to the presence of patients with very small pontine haemorrhages who fared well due to the small volumes of bleed.

Blood Pressure

Systolic blood pressure has been noticed to have significant linear correlation with the outcome and patients who had a systolic blood pressure >160 mm of Hg (74%) had a poor outcome**. ($p<0.05$).**

Pulse pressure was noticed to have a significant positive correlation to the outcome **($p<0.001$)** while diastolic blood pressure was found to have no correlation with outcome.

ICH and ICH-GS scores

The ICH score, which comprises of five variables, age, GCS on admission, volume of bleed, intra-ventricular extension and location of bleed was calculated in all the patients.

Of the patients with a score of 0 only 4.3% of patients had a poor outcome, where as patients with a score of 1 had a poor outcome in 58.5% times. Patients with a score of 2 or more had a 95.2% chance of a poor outcome. Thus, the ICH score can be used for both risk stratification of patients for better intensive management as well as for prognostication of outcome.

The Intra Cerebral Haemorrhage Grading Scale (ICH-GS) has the same variables as the ICH score, but is different in that the various parameters (age, GCS and volume of bleed) are evenly spread out, and every negative factor is given a score of 1. Thus it can range from 5 to 13. This enables us to stratify our patients in greater detail as compared to the ICH score and thereby provide better management to the patients with a high probability of worse outcome and thereby ensure optimal utilization of available resources.

In this study, the ICH-GS scale was found to show a linear highly significant correlation (**$p<0.001$**) with the grades of outcome as assessed by the modified Ranking Score. Death or severe disability was noted in 10%, 15%, 55 %, 90%, almost 100 % of the patients with an ICH-GS score of 5,6,7,8 and more than 9 respectively.

At the outset, the ICH-GS might seem more elaborate as compared to the ICH score but since the parameters are the same, and the results better, ICH-GS might be a better scale to adopt in the emergency room.

CONCLUSION

1. The **risk factors** as identified in the study are increasing **age** and **hypertension.**

2. Siriraj score and Allen score were able to identify haemorrhages based on clinical details in 57.3% and 50.6% of patients, making the scores not reliable enough to replace the CT.

3. Age, systolic blood pressure on admission, GCS, NIHSS on admission, volume of bleed, intra-ventricular extension were all identified as independent predictors of outcome.

4. **The Intracerebral Haemorrhage(ICH) score** and **Intracerebral Haemorhage Graded Score(ICH-GS**) are simple tools that could be used for risk stratification as well as prognostication of outcome.

Further research

Similar studies in larger population to identify epidemiological trends, and consolidate the ICH and ICH-GS Scores as outcome predictors.

Application of Essen Intracerebral haemorrhage score[49] and FUNC Score[50] in predicting the functional outcome after haemorrhage in our population.

ABBREVIATIONS &ACRONYMS

ICH	:	Intra cerebral haemorrhage.
GCS	:	Glasgow Coma Scale
NIHSS	:	National Institute of Health Stroke Scale
ICH score	:	Intra Cerebral Haemorrhage Score
ICHGS	:	Intra Cerebral Haemorrhage Graded Scale
CT	:	Computed Tomography.

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PROFORMA

Name: Age: Sex:

Unit : IP No.: Min No.:

Address:

Phone No.

Date and Time of ictus:

Date and time of admission: In any centre: In our centre:

Arrival time in EMD after ictus:

Educational status	:	Primary school / Secondary school / U.G. / P.G. / Professional / uneducated
Religion	:	Hindu / Muslim / Christian / Others
Income	:	Low / Middle / High
Relevant medical conditions:		DM / HT / Others
Habits	:	Ethanol / Smoking
Symptoms at onset	:	Headache / Vomiting / LOC / Seizures / Limb weakness / Speech disturbance / Sensory loss / Visual disturbances
Activity when symptoms noticed first	:	Sleep / on awakening / while rest / light activity / Heavy exertion / others

H/O Bleeding Disorder or Anticoagulant use :

Antiplatelet / thrombolytic agent :

Pulse / BP :

RR : Temp : BMI :

E/o bleeding (systemic or peripheral) :

CVS, RS, Abd, others :

Table 1: ***Glasgow Coma Scale (* GCS)**

Eye Opening Response	Spontaneous--open with blinking at baseline	4
	Opens to verbal command, speech, or shout	3
	Opens to pain, not applied to face	2
	None	1
Verbal Response	Oriented	5
	Confused conversation, but able to answer questions	4
	Inappropriate responses, words discernible	3
	Incomprehensible speech	2
	None	1
Motor Response	Obeys commands for movement	6
	Purposeful movement to painful stimulus	5
	Withdraws from pain	4
	Abnormal (spastic) flexion, decorticate posture	3
	Extensor (rigid) response, decerebrate posture	2
	None	1

Table 2 National Institute of Health-Stroke Scale (NIHSS)

NIH STROKE SCALE ITEM	Scoring Definitions
1a. LOC	0–alert and responsive 1–arousable to minor stimulation 2–arousable only to painful stimulation 3–reflex reponses or unarousable
1b. LOC Questions--Ask pt's age and month. Must be exact.	0–Both correct 1–One correct (or dysarthria, intubated, foreign lang) 2–Neither correct
1c. Commands--open/close eyes, grip and release non-paretic hand, (Other 1-step commands or mimic ok)	0–Both correct (ok if impaired by weakness) 1–One correct 2–Neither correct
2. Best Gaze--Horizontal EOM by voluntary or Doll's.	0–Normal 1–partial gaze palsy; abnl gaze in 1 or both eyes 2–Forced eye deviation or total paresis which cannot be overcome by Doll's.
3. Visual Field--Use visual threat if nec. If monocular, score field of good eye.	0–No visual loss 1–Partial hemianopia, quadrantanopia, extinction 2–Complete hemianopia 3–Bilateral hemianopia or blindness
4. Facial Palsy--If stuporous, check symmetry of grimace to pain.	0–Normal 1–minor paralysis, flat NLF, asymm smile 2–partial paralysis (lower face–UMN) 3–complete paralysis (upper & lower face)
5. Motor Arm–arms outstretched 90 deg (sitting) or 45 deg (supine) for 10 secs. Encourage best effort. Circle paretic arm in score box	0–No drift x 10 secs 1–Drift but doesn't hit bed 2–Some antigravity effort, but can't sustain 3–No antigravity effort, but even minimal mvt counts 4–No movement at all X–unable to assess due to amputation, fusion, fx, etc.
6. Motor Leg–raise leg to 30 deg supine x 5 secs.	0–No drift x 5 secs 1–Drift but doesn't hit bed 2–Some antigravity effort, but can't sustain 3–No antigravity effort, but even minimal mvt counts 4–No movement at all X–unable to assess due to amputation, fusion, fx, etc.
7. Limb Ataxia--check finger-nose-finger ; heel-shin; and score only if out of proportion to paralysis	0–No ataxia (or aphasic, hemiplegic) 1–ataxia in upper or lower extremity 2– ataxia in upper AND lower extremity X–unable to assess due to amputation, fusion, fx, etc.
8. Sensory--Use safety pin. Check grimace or withdrawal if stuporous. Score only stroke-related losses.	0–Normal 1–mild-mod unilateral loss but pt aware of touch (or aphasic, confused) 2–Total loss, pt unaware of touch. Coma, bilateral loss
9. Best Language--Descr ibe cookie jar picture, name objects, read sentences. May use repeating, writing, stereognosis	0–Normal 1–mild-mod aphasia; (diff but partly comprehensible) 2–severe aphasia; (almost no info exchanged) 3–mute, global aphasia, coma. No 1 step commands
10. Dysarthria--read list of words	0–Normal 1–mild-mod; slurred but intelligible 2–severe; unintelligible or mute X–intubation or mech barrier
11.Extinction/Neglect-- simultaneously touch patient on both hands, show fingers in both vis fields, ask about deficit, left hand.	0–Normal, none detected. (vis loss alone) 1–Neglects or extinguishes to double simult stimulation in any modality (vis, aud, sens, spatial, body parts) 2–profound neglect in more than one modality

Table 3 ICH-GS and ICH score

ICH-GS		ICH Score	
Characteristic	Points	Characteristic	Points
Age, years		Age, years	
<45 years	1	<80 years	0
45–64 years	2	≥80 years	1
≥65 years	3		
GCS score at hospital admission		GCS score at hospital admission	
13–15	1	13–15	0
9–12	2	5–12	1
3–8	3	3–4	2
ICH location		ICH location	
Supratentorial	1	Supratentorial	0
Infratentorial	2	Infratentorial	1
ICH volume		ICH volume	
For supratentorial location		<30 mL	0
<40 mL	1	≥30 mL	1
40–70 mL	2		
>70 mL	3		
For infratentorial location			
<10 mL	1		
10–20 mL	2		
>20 mL	3		
Extension into ventricles		Extension into ventricles	
No	1	No	0
Yes	2	Yes	1

Table 4 Siriraj score

Variable	Clinical feature	Score
Consciousness (x2.5)	Alert	0
	Drowsy, stupor	1
	Semi coma, coma	2
Vomiting (x2)	No	0
	Yes	1
Headache within two hours (x2)	No	0
	Yes	1
Diastolic blood pressure	(x0.1)	
Atheroma markers (x3)	None	0
Diabetes, angina, Claudication	One or more	1
Constant		-12

Table 5 Guy Allen score

Variable	**Clinical feature**	**Score**
Apoplectic onset:		
Loss of consciousness	None or one	0
Headache within two hours	Two or more	21.9
Vomiting		
Neck stiffness		
Level of consciousness	Alert	0
(24 hours after admission)	Drowsy	7.3
	Unconscious	14.6
Plantar responses	Both flexor or single extensor	0
	Both extensor	7.1
Diastolic blood pressure		(x0.17)
Atheroma markers		
Diabetes, angina, intermittent	None	0
claudication	One or more	-3.7
History of hypertension	Not present	0
	Present	-4.1
Previous event	None	0
Transient ischaemic attack	Any number	-6.7
Heart disease	None	0
	Aortic or mitral murmur	-4.3
	Cardiac failure	-4.3
	Cardiomyopathy	-4.3
	Atrial fibrillation	-4.3
	Cardiomegaly	-4.3
	Myocardial infarct	-4.3
Constant		-12.0

Table 6 Modified Ranking Score

Ranking Grade	Description
0	No symptoms
1	No significant disability despite symptoms; able to carry out all usual duties and activities
2	Slight disability: unable to carry out all previous activities but able to look after own affairs without assistance
3	Moderate disability: requiring some help, but *able to walk without assistance
4	Moderately severe disability: unable to walk without assistance, and unable to attend to own bodily needs without assistance
5	Severe disability: bedridden, incontinent, and requiring constant nursing care and attention
==========	===
6	Death

CT findings:

ICH (Location, Volume, oedema) :

IVH (Volume) :

Surgery :

Conservative Treatment :

In-hospital complications :

Investigations :